

# Radiographic Signs of Acute Suppurative Cholecystitis

JAMES J. McCORT, M.D., San Jose

THE CLINICAL FINDINGS in acute cholecystitis are well known and when they follow the classical pattern the diagnosis is readily made. When the symptoms or signs are atypical, the plain film radiographic examination is helpful. In a few instances the radiographically shown complications of acute cholecystitis make operation imperative.

In a 12-month period, 35 patients were admitted to the Santa Clara County Hospital with symptoms and signs of acute cholecystitis. Twenty-six of them had preoperative roentgenograms and in 17 of the 26 confirmatory evidence of an acute inflammatory process in the gallbladder was found.

## Pathologic Features

The pathologic sequence of acute inflammatory changes in the gallbladder is initiated by stasis or obstruction. Occlusion of the cystic duct by stone or inflammatory exudate results in the retention of bile and produces a tense, swollen gallbladder.<sup>3</sup> Bacterial infection is soon superimposed and if drainage does not occur spontaneously the infection will extend through the wall of the gallbladder. At this point there is swelling and edema of contiguous structures. The gallbladder wall will undergo necrosis and perforation follows, first with localized and later with generalized peritonitis.

## Technique of Examination

The roentgen diagnosis of acute inflammatory processes within the abdomen has been described in the past by Laurell,<sup>6</sup> Friman-Dahl<sup>4</sup> and Young.<sup>14</sup> The diagnostic value of preliminary plain film examination is well proven. For this reason patients admitted to the Santa Clara County Hospital with signs and symptoms indicating infection or tumefaction in the abdomen are routinely examined radiographically. Three films of the abdomen are taken: (1) An anteroposterior in the supine position, (2) a posteroanterior in the upright position (if the patient is able to cooperate; otherwise, prone), and (3) a left lateral decubitus film. Serial abdominal films are taken when the diagnosis remains in doubt.

How the patient is dealt with then depends on analysis of these three films and a correlation with

• In a recent series of 26 pathologically proven cases of acute cholecystitis, preoperative radiographic examination of the abdomen confirmed the presence of an inflammatory process in 17.

The radiographic signs associated with acute suppurative cholecystitis are:

1. Enlargement of the gallbladder, as indicated by separation or alteration in position of opaque calculi or indentation of adjacent bowel.

2. Localized peritoneal irritation, manifested by (a) ileus of hepatic flexure of colon; (b) ileus of duodenal loop; (c) effacement of haustra of the hepatic flexure or valvulae conniventes of the duodenum; (d) obscuration of fat line marking inferior border of liver.

3. Cholecystitis emphysematosa.

4. Perforation of gallbladder, which if localized (retroperitoneal) is manifested by bubbles of gas in the gallbladder bed. If generalized (intraperitoneal) the signs are adynamic ileus of small and large bowel, increased intraperitoneal fluid, subdiaphragmatic abscess and plate atelectasis of right lung base.

Visualization of the gallbladder and biliary tree after intravenous cholecystography rarely occurred in the presence of acute cholecystitis.

Plain film examination of the abdomen aids in establishing the diagnosis of an acute cholecystitis and leads to the early recognition of complications such as perforation and peritonitis.

the clinical findings. A patient with a perforated viscus is prepared for immediate operation. If urinary abnormalities are present, an intravenous urogram is carried out. When there is indication of large bowel obstruction, the colon is studied by barium enema. If small bowel obstruction is indicated, the patient is given 100 cc. of 25 per cent Hypaque® solution, or 3 ounces of barium mixture, by nasogastric tube and hourly films are taken.

When disease of the gallbladder is suspected, an intravenous cholecystogram is obtained. In the present series, visualization of the gallbladder or the bile ducts occurred only once in the presence of acute inflammation. Thus, visualization of the gallbladder seems strong evidence against acute cholecystitis, although it does not exclude that diagnosis.

## Radiographic Signs

An acutely inflamed and obstructed gallbladder tends to increase in size. (Ordinarily the gallbladder

Presented before the Section on Radiology at the 87th Annual Session of the California Medical Association, Los Angeles, April 27 to 30, 1958.

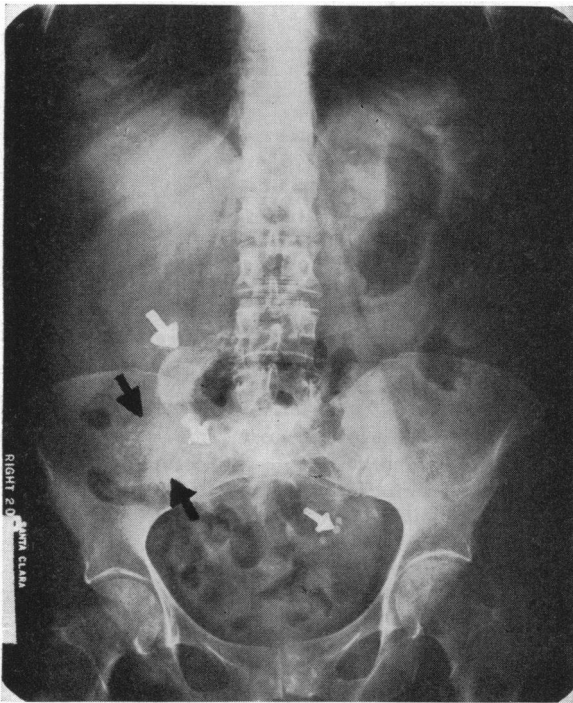


Figure 1.—*Enlargement of gallbladder shown by widely separated stones.* The patient, a 54-year-old woman, had had abdominal pain for a week and jaundice for four days. A mass was palpable in the right upper quadrant of the abdomen, and results of laboratory tests were indicative of extrahepatic biliary obstruction. A preliminary film of the abdomen showed the liver edge to be low in position. There was a smoothly rounded mass in the right abdomen lying over the sacroiliac joint (black arrows). It contained widely separated stones. These observations were compatible with a distention of the gallbladder. The larger calcification superior to the mass as well as the two clusters of three calcifications close to the midline (white arrows) were identified at operation as being in the omentum.

At operation the liver was observed to extend 7.5 cm. below the right costal margin and was somewhat nodular. The gallbladder was about three times normal size and contained many small stones. Pronounced edema and inflammation was noted about the common duct, cystic duct and Hartmann's pouch. The head of the pancreas was indurated and there was amorphous material in the common duct. Microscopic study of the gallbladder showed acute and chronic cholecystitis with cholelithiasis.

cannot be delineated radiographically from the surrounding soft tissue structures because it is of identical density.) If it contains radiopaque stones, it is readily identified. Wide separation of gallstones or a decided alteration in position of stones between the prone and upright films indicates the gallbladder is distended with fluid (Figure 1). Unfortunately, less than one-fifth of gallbladder stones contain enough calcium to be visualized on a plain film.<sup>14</sup>

The enlarged gallbladder may make itself evident by indenting or displacing the adjacent bowel loop (Figure 2).<sup>12</sup> These loops are usually distended with gas (as in Figure 2), causing the "pelotte-effect" described by Friman-Dahl.<sup>5</sup> Careful inspection is

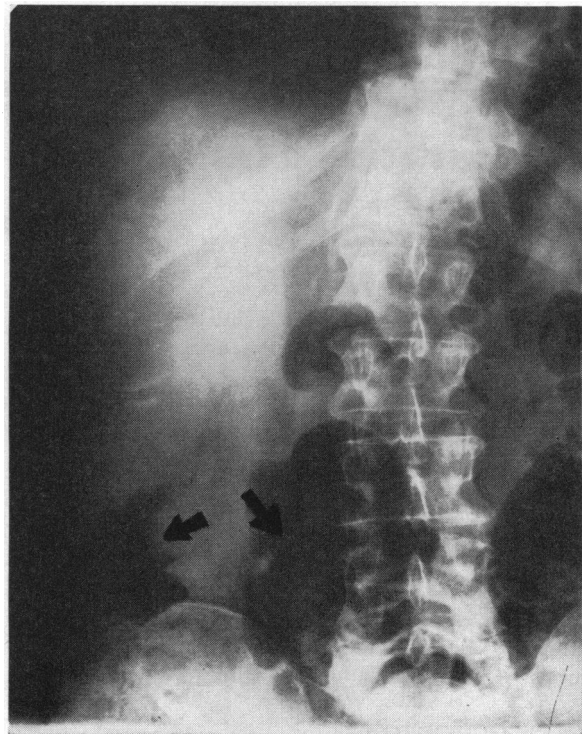


Figure 2.—*Indentation and downward displacement of the colon by an enlarged gallbladder.* On the morning of admission the patient, a 72-year-old white man, had non-radiating epigastric pain. The abdomen was flat. Rigidity and tenderness to palpation was noted in the right upper quadrant. Leukocytes numbered 10,500 per cu. mm., 80 per cent segmented forms. A film of the abdomen taken after admission showed the hepatic flexure and transverse colon to be filled with gas. The hepatic flexure was displaced downward and its superior margin was indented by the dilated gallbladder (black arrows). Further, the margins of the colon which are in contact with the gallbladder are rendered indistinct by the associated inflammatory process.

At operation the gallbladder was found to be extremely enlarged, thick-walled, inflamed and distended. Surrounding it were a moderate number of omental adhesions. The gallbladder was removed and upon microscopic examination the wall was observed to be greatly thickened and edematous. Recovery was uneventful.

necessary to distinguish the distended gallbladder from the lower pole of the right kidney.

Localized peritoneal irritation will result in ileus of the adjacent bowel.<sup>7</sup> This is most common in the hepatic flexure of the colon (Figure 3). It is necessary to differentiate this dilated and atonic hepatic flexure from the chance occurrence of localized flatus. Placing the patient in a decubitus or upright position will usually cause flatus to pass along the colon. An atonic segment will remain dilated.

The next most common site of ileus, in the present series, was the second portion of the duodenum. Because of its close anatomical relationship to the gallbladder and its attachment to the liver by the hepatoduodenal ligament, it is easily subjected to irritation (Figure 4).

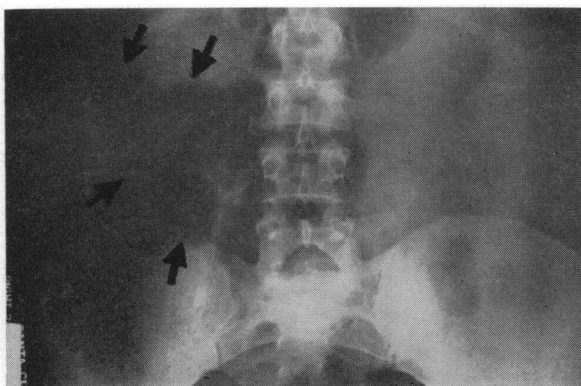


Figure 3.—*Ileus of hepatic flexure.* The patient was a white woman 30 years of age who entered the hospital with a history of stabbing pain in the right upper quadrant of the abdomen following the ingestion of fatty foods. Nausea and vomiting were present. On the third hospital day the temperature reached 104°F. and leukocytes numbered 11,400 per cu. mm. A plain film of the abdomen showed a localized ileus of the hepatic flexure (arrows). The liver edge was obscured.

At operation the gallbladder was seen to be red, edematous and thickened. It was full of pus and contained 12 stones. Edema extended down to and included the hepatoduodenal ligament.



Figure 4.—*Dilatation of the duodenum due to acute cholecystitis.* The patient was a 23-year-old woman who was admitted with localized and progressively severe epigastric pain which had begun some 12 hours earlier, shortly after a breakfast consisting of bacon and fried eggs. Bowel sounds were hypoactive and there was very pronounced tenderness in the right upper quadrant of the abdomen, associated with a questionable mass. The film of the abdomen showed pronounced dilatation of the second portion of the duodenum (black arrows). The lateral aspect of the duodenum was indented by the enlarged gallbladder and the margin of the duodenal wall in contact with the gallbladder was rendered indistinct by the associated inflammatory reaction.

At operation the cholecystoduodenal ligament and the gastrocolic ligament were observed to be thickened with edema and inflammatory reaction. The gallbladder was distended to approximately twice normal size and showed an early necrotic exudate over the fundus. Edema extended down over Hartmann's pouch and through the area of the lesser sac and foramen of Winslow. Also observed were vascular engorgement and distention of the peritoneal reflection over the cystic and common ducts as well as the adjacent vessels. A stone was found in the cystic duct.

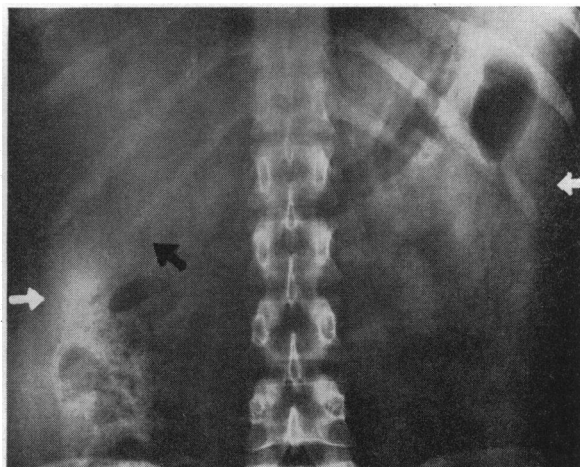


Figure 5.—*Obscuration of the liver edge caused by acute inflammation of the hepatoduodenal ligament.* The patient had constant, cramping and nonradiating epigastric pain of 24 hours duration. Moderate guarding in the right upper quadrant of the abdomen was noted. No masses were palpable. The temperature was not above normal range. Leukocytes numbered 14,700 per cu. mm.—80 per cent segmented forms. On the plain film of the abdomen the line of diminished density which defined the lower border of the liver was obscured (black arrows). The layer of pericolic fat believed to cause this line was obscured by the inflammatory edema. In contrast the lateral border of the liver and the inferior border of the spleen were sharply defined (white arrows).

At operation the gallbladder was large and tense and contained several large stones. The wall of the gallbladder and the gastrohepatic ligament were decidedly indurated, which obscured all structures in the gastrohepatic ligament.



Figure 6.—*Effacement of the valvulae conniventes of the duodenum due to edema of the duodenal wall.* The patient, an obese 20-year-old girl, was five months pregnant when admitted with abdominal pain in the right upper quadrant one and a half days' duration. She gave a history of two previous attacks. The uterus was enlarged almost to the umbilicus. The temperature on admission was 102°F. and leukocytes numbered 24,300 per cu. mm.—86 per cent segmented forms. The preliminary film of the abdomen showed pronounced dilatation of the second portion of the duodenum. The anatomical location and the absence of fecal material identified this dilated loop as duodenum (black arrows). The valvulae conniventes were completely effaced by the inflammatory process.

At operation the gallbladder was found to be twice normal size and its wall decidedly thickened and edematous with extension of the acute reaction into the portal triad. The cystic duct was also swollen but not dilated.

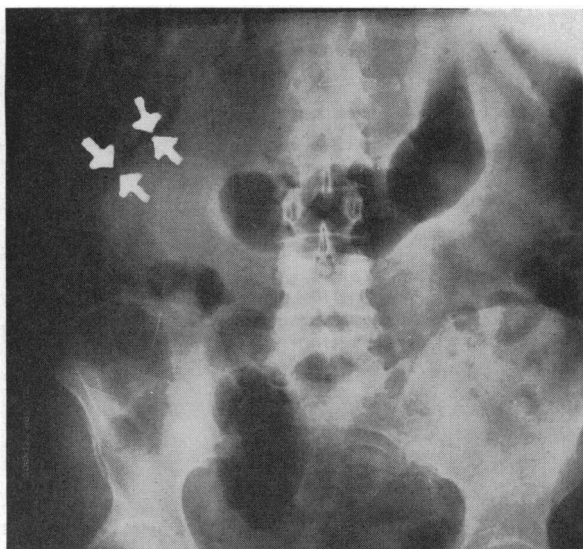


Figure 7.—*Acute cholecystitis with perforation into the gallbladder bed.* The patient, a woman 53 years of age, was well until five days before admission when vomiting, nausea and severe pain in the right upper quadrant of the abdomen developed. The abdomen was protuberant and bowel sounds were hyperactive. The film of the abdomen revealed a large, pear-shaped mass consistent with an enlarged gallbladder surrounded by bubbles of gas along its lateral aspect (arrows). The mass depressed the hepatic flexure and the transverse colon. A film of the chest showed plate-like areas of atelectasis at the right lung base, presumably due to splinting of the diaphragm.

At operation, the gallbladder was found to be perforated and acute cholecystitis was present. An operative cholangiogram showed two stones in the common duct, which were removed. Recovery was uneventful.

Because the hepatoduodenal ligament lies directly over the gallbladder, it is not uncommon to find it swollen and edematous at the time of operation. This swelling and edema tends to obliterate the line of fat which is responsible for visualization of the lower border of the liver. In comparison, the lower pole of the spleen will be readily visualized (Figure 5).

As the inflammation extends, the wall of the adjacent colon will likewise become edematous and swollen, resulting in an effacement of the normal mucosal markings and haustra. A similar change in the duodenum will result in an erasure of the valvulae conniventes (Figure 6). Friman-Dahl drew attention to this highly typical finding.<sup>5</sup> The examiner can be certain that he is dealing with duodenum by its anatomical location and the absence of fecal material. When doubt exists, giving Hypaque by mouth will serve to outline and thereby identify the duodenum.

Rarely cholecystitis emphysematosa will be found, the result of a gas-producing bacterial infection within the gallbladder. Gas within the gallbladder also results from a cholecystoenteric fistula, but this



Figure 8.—*Generalized peritonitis and subphrenic abscess following perforation of an empyema of the gallbladder.* The patient was admitted to the hospital with abdominal pain of six hours' duration. Since the onset of symptoms he had been anorexic. The last bowel movement was two days before. There was no melen. The patient had never been jaundiced. The temperature was 99.4°F., the pulse rate 104 and respirations 22 per minute. Decided guarding in the right upper quadrant of the abdomen was noted, but no masses were palpable. Rebound tenderness was present throughout the abdomen. The x-ray film of the abdomen showed a mass in the right upper quadrant compatible with a distended gallbladder. Medial to the mass were several small bubbles of gas (black arrows). The right leaf of the diaphragm was elevated and there was a small pocket of gas beneath the diaphragm (white arrow). The presence of gas pockets over the liver was confirmed by a radiograph obtained in the lateral decubitus position. In addition, there was an adynamic ileus of the large and small bowel, with evidence of increased intraperitoneal fluid.

At operation bile-stained fluid welled up when the peritoneum was opened. The gallbladder had perforated and there were multiple small stones in and around it. Pockets of bile-stained fluid separated the liver from the diaphragm. The abscesses were drained and the patient recovered.

possibility can be excluded by a barium examination of the upper gastrointestinal tract.<sup>10</sup>

Small bubbles of gas in the retroperitoneal tissues around the gallbladder are indicative of perforation (Figure 7). They are due to gas-producing organisms. When they are present, surgical treatment is imperative and delay in drainage may be hazardous.

When the gallbladder perforates into the peritoneal cavity, peritonitis with diffuse ileus results. As the infectious process spreads there will be radiographic signs of increased peritoneal fluid, right subdiaphragmatic abscess and right pleural effusion (Figure 8).

Differentiating between acute pancreatitis and acute cholecystitis is difficult radiographically. Localized ileus of the colon and the upper small bowel

is present in acute pancreatitis.<sup>2,9,15</sup> Impaired pancreatic function will be indicated by elevated serum amylase. Unfortunately, visualization of the gallbladder and common duct is likewise impaired in uncomplicated pancreatitis, following an intravenous Cholografin test.<sup>11</sup>

Santa Clara County Hospital, San Jose-Los Gatos Road, San Jose.

#### REFERENCES

1. Alvarez, W. C., and Hosoi, K.: What has happened to unobstructed bowel that fails to transport fluid and gas, *Am. J. Surg.*, 6:569-578, 1929.
2. Barry, W. E., Jr.: Roentgen examination of abdomen in acute pancreatitis, *Am. J. Roent. Rad. Ther. & Nuc. Med.*, 74:220-225, 1955.
3. Cole, W. H., Novak, M. H., and Hughes, E. O.: Experimental production of chronic cholecystitis by obstructive lesions of the cystic duct, *Ann. Surg.*, 114:682, 1941.
4. Friman-Dahl, J.: Roentgenological examination of ileus, *Acta Radiol.*, 28:331-351, 1947.
5. Friman-Dahl, J.: Roentgen Examinations in Acute Abdominal Diseases, Chas. C. Thomas, Springfield, Ill., 1st ed., p. 248, 1951.
6. Laurell, H.: Roentgen befunde bei akuten Erkrankungen der Bauchohle, *der Chirurg.*, 2:422-434, 1930.
7. Levitin, J.: Intraperitoneal localized abscess; roentgenologic aid in diagnosis, *Radiology*, 37:205-207, 1941.
8. Levitin, J.: Scout film of the abdomen, *Radiology*, 47:10-30, 1946.
9. Paxton, J. R., and Payne, J. H.: Acute pancreatitis, *Surg., Gyn. & Obst.*, 93:69-75, 1948.
10. Quist, C. F.: Cholecystitis emphysematosa, *Acta Radiol.*, 35:200-206, 1951.
11. Sanchez-Ubeda, R., Ruzicka, F., and Rausellot, L.: Effect of peritonitis of nonbiliary origin on the function of the gallbladder as measured by cholecystography, its frequency and its duration, *N.E.J.M.*, 257:389-403, 1957.
12. Scanlan, R. L., and Young, B. R.: Roentgen diagnosis of gallbladder and biliary tract disease without cholecystography, *Am. J. Roent.*, 72:639-643, 1954.
13. Steinert, R., Haseide, I., and Christiansen, T.: Roentgenologic examination of acute appendicitis, *Acta Radiol.*, 24:13, 1943.
14. Young, B. R.: Roentgen examination of the acute abdomen, *Radiology*, 64:481-495, 1955.
15. Young, B. R.: Significance of regional or reflex ileus in the roentgen diagnosis of cholecystitis, perforated ulcer, pancreatitis and appendiceal abscess as determined by survey examinations of the abdomen, *Radiology*, 78:581-586, 1957.

